UNIVERSITY OF FLORIDA

Center for Aquatic Weeds

AQUAPHYTE

International Plant Protection Center

AQUATIC WEED PROGRAM

VOLUME 4 NUMBER 1 GAINESVILLE, FLORIDA SPRING 1984

IPPC AQUATIC WEED SURVEY IN ECUADOR

A major hydroelectric project in Ecuador's Rio Guayas Basin is being threatened by dense infestations of water hyacinths *(Eichhornia crassipes)*. The floating pest, which is not native to Ecuador, has taken over some lakes and rivers and could impact the 24,000 hectare reservoir which is under construction. Some Ecuadorans have had to abandon their homes after flooding brought compacted water hyacinth mats to their front doors, and some flooded rice fields have been covered with water hyacinth.

The Instituto Nacional de Investigaciones Agropecuaria (INIAP) and the Comsion de Estudios para el Desarrollo de la Cuenca del Rio Guayas (CEDEGE) of Ecuador are attempting to control the water hyacinth before the completion of the new hydroelectric reservoir in 1987. To obtain more information on water hyacinth control, INIAP invited Drs. William Haller and Joseph Joyce (U.F. Center for Aquatic Weeds) to Ecuador. The trip was sponsored by CEDEGE, INIAP, the IPPC-Aquatic Weed Program of the University of Florida, and the U.S. Agency for International Development.

In the week-long visit (22-29 April 1984), the two aquatic plant specialists surveyed the basin's problems, observed control efforts and made suggestions for Ecuadoran research and control initiatives under way at the INIAP research stations in Guayaquil and Boliche. Haller and Joyce also presented a seminar on water hyacinth which was attended by more than 120 Ecuadoran researchers and others.

It is expected that this trip will result in further contacts among researchers concerning biological, chemical and mechanical control programs for water hyacinths. Regarding biological controls, Haller noted that, although *Neochetina* has been reported in Ecuador, there are no signs of feeding or other insect damage on water hyacinths in the Rio Guayas Basin.

LIMNOLOGIST AT WORK

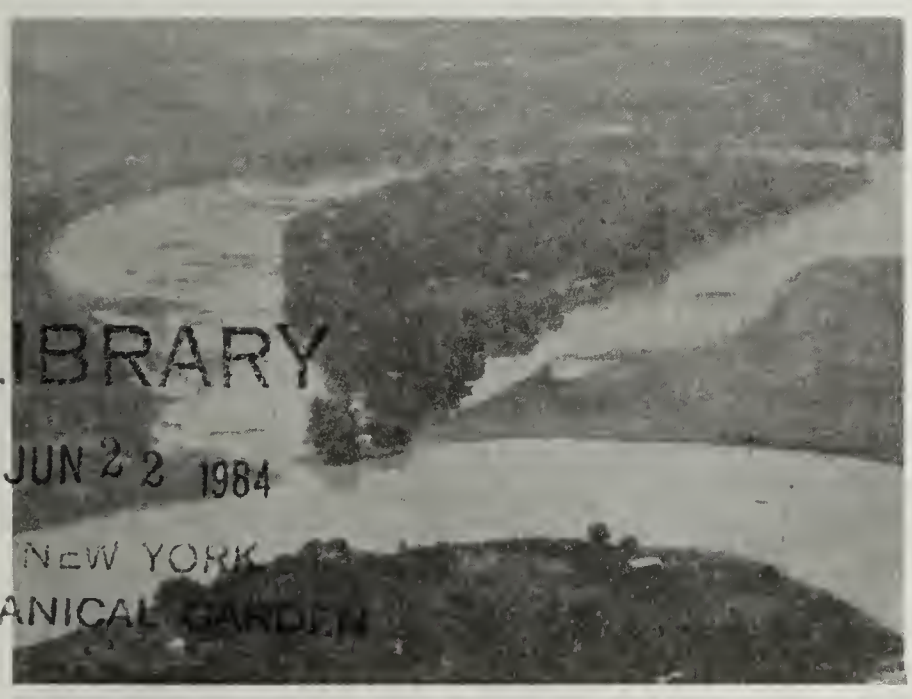
Basic research on the causes and effects of eutrophication in lakes has been carried out for many years, but no unifying model of aquatic ecosystem behavior, relating to nutrient enrichment, has been devised. The reason is that there are many causes and effects which, to be understood, require expert knowledge of geology, hydrology, limnology, botany, and zoology. Pooling the qualitative and quantitative research knowledge of these disciplines is essential for the development of an ecosystem model which would have good predictive capacity. But, in fact, much more basic information must be collected in all of these areas before the development of a unified ecosystem model which could be used for nutrient management can be realistically attempted. Dr. Daniel Canfield is among those whose research has yielded equations which may become part of a larger ecosystem predictive model. Canfield is a limnologist at the University of Florida Center for Aquatic Weeds.

According to Canfield, many of Florida's lakes have been affected by man's activities, and 1,000 more new residents a day are placing more pressure on them. Shore development, wastewater release, fertilizer runoff and heavy industry are among the sources contributing to lake eutrophication. Since nutrient input to watersheds and lakes will continue, it must be managed; it cannot be totally eliminated. Canfield says basic principles of nutrient management remain undefined yet everyone wants to know in what ways lakes have been altered, how to restore them, how to further utilize them and how to accomodate their many uses in the future.

Prior to the implementation of a lake management program, the "management objectives" must be clearly stated and these objectives must be realistic in terms of how particular lakes function. Are the lakes to be used for fishing, boating, swimming or are they to be used as sources of drinking water or as wastewater sites? Most Florida lakes, for example, are "multi-use" lakes, each with its own ecological balance. A predictive ecosystem model would be a primary tool used to manage the complex balancing of multi-use lakes.

With respect to aquatic plants, for example, a good aquatic ecosystem model would predict the effects of removing aquatic "weeds" from lakes and answer such questions as, "How will removing certain volumes of aquatic plants affect nutrient concentrations in water and sediment and how will it affect the clarity of the water?" and "How many plants are necessary to maintain natural fish productivity in particular lakes?" Before a reliable model can be developed, according to Canfield, basic ecological questions must be answered. Among them are: How does the surrounding geology affect nutrient flow (from crop runoff, for example) before the nutrients reach lakes? How much phosphorus and nitrogen falls to the sediment, how much stays in the water column, how much

Continued on page 2



ABOVE: Oxbow lakes, canals and lowlands adjacent to the rivers in the Guayas River Basin in Ecuador provide a growing area for water hyacinths during the dry season.

RIGHT: During the wet season, water hyacinths flow out of upstream oxbow lakes and canals, down the Guayas River and into the Gulf of Guayaquil. Construction of an upstream reservoir on the Daule-Peripa rivers will likely prevent many of these plants from reaching the Gulf. The plants could cause problems in the 20,000 hectare reservoir.

LIMMOLOGIST
Continued from page 1

is taken up by macrophytes and algae, how much does pH affect nutrient availability? How does lake morphometry and temperature stratification affect nutrient cycling? Do aquatic plants utilize nutrients from the water or from the sediment or from both and do plant epiphytes and free plankton utilize more or less nutrients than do macrophytes? Do plants constantly "pump" nutrients into the ecosystem or are nutrients released only when the plants die? Canfield has addressed some of these questions in his basic and applied research projects.

One large Canfield project related Florida's various geological formations to the trophic states of 165 lakes within the formations. Canfield collected information on the water chemistries and transparencies of these lakes. Alkalinity, specific conductance, hardness concentrations, nutrient content, chlorophyll a concentrations and Secchi depths were measured and the lakes were classified from ultra-oligotrophic to hyper-eutrophic. He concluded there is a strong relationship between the mineral composition of the lakes and their surrounding surface geology and physiography. For example, sandridge lakes are characterized by clearer and less productive water than those from lower parts of Florida which tend to be more nutrient rich and are more likely to be or to become eutrophic. This basic research data has provided information for ecosystem models which are being developed. For example, the data were used in the development of models to predict zooplankton abundance from measures of chlorophyll a concentrations.

Other work by Canfield includes the development of a model which can predict phosphorus levels equally well in natural or artificial lakes. The model has a 95% confidence interval of 31-288% of the calculated total phosphorus concentration. Another Canfield model can predict chlorophyll a concentrations with a 95% confidence interval of 29-319% of the calculated chlorophyll a concentrations.

Recent work indicates that removal of aquatic plants can affect water quality more than the methods used for their removal. A research report by Canfield and others recently combined the areas of basic research on lake functioning with applied research of aquatic plant removal and its effects. Their research indicated that, for a heavily infested lake, the actual removal of hydrilla had more to do with the lake's resulting water quality than did the use of grass carp as a biological control. Taking away the hydrilla resulted in reduced water clarity from increased chlorophyll a concentrations. What about the effects on the fish in the lake? The researchers concluded, "What changes will occur in total fish biomass and species composition if aquatic macrophytes remain eliminated from a lake are presently unknown."

Another Canfield project is the development of a model which predicts effects of chlorophyll on the transparency (clarity) of lake water, in relation to the lake's trophic state and its volume of aquatic plants. As stated in a soon to be published article, "an analysis of chlorophyll a data collected from a Florida lake demonstrated that chlorophyll yields were reduced as the percentage of the lakes' total volume infested with aquatic macrophytes increased": water clarity was predicted to increase in all trophic

Continued on page 9

FIRST ANNOUNCEMENT OF MILFOIL SYMPOSIUM

Eurasian watermilfoil *(Myriophyllum spicatum)* is an exotic submersed aquatic plant which was introduced into the U.S. at the turn of the century and has since become the most widespread aquatic weed in North America. It is found from Florida to Ontario, from Tennessee to British Columbia.

Plans for the International Symposium on Eurasian Watermilfoil and related species are being made, and the Symposium is expected to take place in conjunction with the National Aquatic Plant Managment Society's annual meetings, to be held in Vancouver, British Columbia in July 1985.

The symposium would gather experts in Eurasian watermilfoil natural history, distribution, taxonomy, physiology, ecosystem effects and controls. The goal would be to determine the current state of world research and suggest possible alternatives to the traditional chemical—mechanical control methods. A "Proceedings" volume would be published.

For more information, contact: Mr. William N. Rushing, Secretary-Treasurer A.P.M.S., P.O. Box 16, Vicksburg, Mississippi 39180, U.S.A.

ICLARM

The International Center for Living Aquatic Resources Management is a non-profit, non-governmental research center whose primary goal is to "improve the condition of the rural poor in developing countries" by helping them increase their utilization of their aquatic resources. ICLARM therefore researches fisheries culture and management practices and applies proved techniques to the improvement of small-scale fisheries. In this way, ICLARM helps people in less-developed areas to meet their nutritional and economic needs.

ICLARM maintains programs in Resource Development and Management, Aquaculture, Traditional Fisheries, Information Service, and Education and Training.

ICLARM publications series includes studies and reviews, conference proceedings, technical reports, bibliographies, translations and newsletters. Among them is the review: FOOD POTENTIAL OF AQUATIC MACROPHYTES by Peter Edwards.

For more information or lists of available publications contact: Director General, International Center for Living Aquatic Resources Management, MCC P.O. Box 1501, Makati, Metro Manila, PHILIPPINES.

SOCIETY MEETS IN JULY

The 24th annual meeting of the Aquatic Plant Management Society, Inc. will be held July 15-18, 1984, in Richmond, Virginia, U.S.A. The conference will take place at the Richmond Hyatt House Hotel. For information, contact: Mr. William N. Rushing, Secretary-Treasurer, A.P.M.S., P.O. Box 16, Vicksburg, Mississippi 39180, U.S.A.; or Mr. Edward O. Gangstad, Local Arrangements Chairman, A.P.M.S., 7909 Greely Boulevard, Springfield, Virginia 22152, U.S.A.

BULLETIN of the SOCIETY OF WETLAND SCIENTISTS

The primary purpose of the Society of Wetland Scientists is "to promote the knowledgeable husbandry of wetland resources." SWS sponsors conferences and meetings (its fifth annual meeting was held in May). It also sponsors a newsletter, SWS BULLETIN, edited by C.T. Hackney. For more information on SWS and to subscribe to the BULLETIN, write: Society of Wetland Scientists, P.O. Box 291, Wilmington, North Carolina, 28402, U.S.A.

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AQUAPHYTE is the newsletter of the Center for Aquatic Weeds and the IPPC Aquatic Weed Program of the University of Florida. The Center for Aquatic Weeds is in the Institute of Food and Agricultural Sciences (IFAS). The International Plant Protection Center (IPPC) is a unit of Oregon State University and is funded by the United States Agency for International Development. Program support is also provided by the Florida Department of Natural Resources.

EDITOR: Victor Ramey

AQUAPHYTE's circulation is 3,500. It is distributed to aquatic biologists and agencies world-wide. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

FLORIDA RESEARCH REVIEW

More than a hundred of Florida's aquatic plant scientists, water managers and government officers convened in January for the annual Florida Aquatic Plant Research Review and Coordination Meeting. The two-day conference was organized and sponsored by the University of Florida Center for Aquatic Weeds, Dr. Joseph Joyce, Director, and was held on the Gainesville campus. Thirty-four presentations reviewed research fronts ranging from new herbicide formulations for weed control to preliminary biocontrol research using aquatic nematodes to biogas research using aquatic weeds as fuel.

Thousands of Florida's lakes and ponds, and thousands of miles of rivers and canals are under siege from several exotic plants, and other aquatic nuisance plants appear yearly. However, the state's various climatic zones and various water chemistries and other ecological conditions support nuisance plant growth in different ways, so that all forms of aquatic weed control are not suitable for all parts of the state. Keeping abreast of changes in effective state-of-the-art management practices, which involve many diverse areas of scientific investigation, is difficult even for full-time water managers and scientists. Therefore, the purpose of Research Reviews, according to Dr. Joyce, is to help managers and scientists remain knowledgeable of new aquatic ecosystem research and to help coordinate management of Florida's aquatic weeds. This kind of information exchange reduces duplication of wasted effort, and results in quicker, ecologically safer, solutions to water management problems.

Some of the presentations reviewed the research programs taking place at the Universities of Florida, Central Florida and South Florida, and Rollins College. Governmental organizations including the U.S. Department of Agriculture, the U.S. Fish and Wildlife Service, the Florida Department of Natural Resources, and the Florida Game and Freshwater Fish Commission and the U.S. Army Corps of Engineers also reviewed their current and future research plans.

Among research areas discussed is the research of Dr. Grover Smart and Dr. Kairn Gerber, whose work on nematodes of aquatic plants has shown that *Ceratophyllum demersum*, for instance, can be highly stressed by the aquatic nematode *Hirschmaniella*. Dr. George Bowes described his lab's work on the physiology of the potential problem plants *Limnophila sessiliflora* and *Hygrophila polysperma*. Dr. Richard Wain described electrophoretic studies of *Cabomba* and *Alternanthera philoxeroides*. Among his conclusions were that there are two biotypes of alligatorweed in the U.S., each of which must have been separately introduced. Dr. David Sutton described his research on the competition between *Hydrilla* and *Eleocharis*, and startled conference members with suggestions for the cloning of *Brontosaurus* for biocontrol of aquatic weeds.

V. Ramey

CZECH LIST

The Institute of Botany Department of Hydrobotany of the Czechoslovak Academy of Sciences publishes many papers about aquatic plants. Subject areas include ecology and physiology, fishpond management, wastewater treatment and nutrient cycling, as well as extensive research on the propagation, management and utilization of *Phragmites communis (P. australis)*.

The department annually produces a publications list, and provides copies of many papers free of charge. For more information, contact: Czechoslovak Academy of Sciences, Institute of Botany, Department of Hydrobotany, Dukelska 145, Trebon 379 82, CZECHOSLOVAKIA.

FINNISH WATER

The Finnish Water Administration and the National Board of Waters is responsible for the promotion of the protection, utilization, management and research of all Finnish water resources and water areas. Nearly 10% of Finland's surface is covered by its 55,000 lakes, and the country has 20,000 km of rivers.

The Board supports water research, and maintains a hydrological library of more than 30,000 volumes. The library maintains a publications exchange program for research on hydrology, limnology, water supply and wastewater treatment. For information on the publications exchange program, and the National Board of Waters, contact: Marja-Liisa Poikolainen, Information Officer, National Board of Waters, Library, P.O. Box 250, SF—00101 Helsinki 10, FINLAND.

BOOKS AND REPORTS

INTRODUCTION TO FRESHWATER VEGETATION. by D. N. Riemer. 1984. AVI Publishing Company, 250 Post Road East, P.O. Box 831, Westport, Connecticut, 06881, USA. 207 pages. About $37.00.

This is the latest of a very few books which might be used as texts in introductory aquatic botany courses. Common species of vascular plants are pictured and briefly described in sections titled Emergent Plants, Floating Unattached Plants, and Submersed Plants, arranged in alphabetical order according to common name. Included are chapters on the diversity of aquatic environments and factors which affect plant life in them, chapters on light and nutrients in aquatic systems, chapters on identification, ecology and adaptations of aquatic plants, and review chapters on the reasons for aquatic plant control and the various forms of control and on utilization. Two appendices list scientific and common names of aquatic plants and herbicides used in aquatic systems.

MONOCOT WEEDS 3. Monocot Weeds Excluding Grasses. by E. Hafliger, U. Kuhn, L. Hamet-Ahti, C.D.K. Cook, R. Faden and F. Speta. 1982. CIBA-GEIGY Ltd., Basle, Switzerland. 156 pages. (In English, German, French and Spanish)

This beautiful, large-format book is packed with information about the morphology and taxonomy of the adventive members of nine families of *Monocotyledons: Cyperaceae, Juncaceae, Alismataceae, Araceae, Hydrocharitaceae, Pontederiaceae, Commelinaceae,* and *Liliaceae.* Also included are identification keys and worldwide geographical distribution data of the 132 species treated. Each species is given a page on which line drawings of the entire plant and plant parts, including fruits, are printed, accompanied by size data and descriptions of stems, leaf parts, infloresences and flowers, and fruits. Habitat, distribution, life forms and common names and synonyms of each species are also listed. Twelve of these plants were chosen to be represented as well in color lithographs bound into the last part of the book. The reverse sides of these lithographs list common names for the pictured plants for as many as thirty countries (for example, "kasikotu" is the Turkish name for *Alisma plantago-aquatica* "sajiomodaka" is the Japanese name.

SIMULATED MECHANICAL CONTROL OF AQUATIC PLANTS IN BUFFALO LAKE, WISCONSIN. by B.M. Sabol. 1983. Miscellaneous Paper A-83-8. Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi, 39180, USA. 49 pages.

This report describes a computer model called HARVEST, which was used here to simulate all the steps required to mechanically control the dominant nusiance plants in a Wisconsin lake. Dominant plants in order of importance were: *Ceratophyllum demersum, Vallisneria americana, Elodea canadensis* and *Myriophyllum exalbescens.* HARVEST calculated system times required for an Aquamarine Model H-650 and H-400 harvesters working alone and with T-650 transporter to perform the control operation.

Continued on page 4

FLORIDA'S AQUATIC PLANT REGULATION PROGRAM

by Mr. Brian Nelson, Department of Natural Resources, Bureau of Aquatic Plant Research and Control, 3900 Commonwealth Boulevard, Tallahassee, Florida 32303.

Due to its warm climate and large tropical fish industry, Florida sustains a large aquarium plant industry. Unfortunately, some of the exotic species imported by this industry such as *Hydrilla verticillata, Myriophyllum aquaticum* and *Myriophyllum spicatum* have become established in natural waters and now behave as noxious weeds. Additional troublesome species including *Eichhornia crassipes* and *Alternanthera philoxeroides* were imported intentionally or accidentally long before the establishment of this industry. As a result of these introductions, expensive control programs are now required to keep many waterways from becoming overgrown and rendered useless by these exotic species.

Recognizing the need to prevent the importation of additional troublesome species and to stop the intentional spread of noxious species already introduced, the Florida Legislature enacted Section 403.271 of the Florida Statutes in 1969. This statute (later numbered Section 369.25) is the basis of Florida's Aquatic Plant Regulation Program.

Under this program a valid permit from the Department of Natural Resources is required to legally import, transport or cultivate aquatic plants. This requirement insures that all persons dealing with aquatic plants are aware of the rules and regulations of the Department having to do especially with those on the list of prohibited aquatic plant species. The importation of aquatic plants is monitored through the cooperation of the United States Department of Agriculture's Miami Inspection Station. Inspection of aquatic nurseries and other businesses involved with the movement of aquatic plants are conducted by Department inspectors to insure compliance. Persons receiving foreign shipments of aquatic plants are frequently inspected.

Persons importing aquatic plants into the state without a valid permit can have the shipment returned to the country of origin and/or seized for legal proceedings. Persons transporting or cultivating aquatic plants within the State of Florida in violation of Section 369.25 Florida Statutes, and/or Chapter 16C-19, Florida Administrative Code, are subject to prosecution as provided in Section 775.082, or Section 775.083, Florida Statutes.

The following prohibited aquatic plants are considered detrimental to the aquatic resources of the State. They cannot be imported, transported or cultivated into/within the State of Florida.

Scientific permits for the importation, transportation and cultivation of prohibited species may be issued to research agencies or institutions for educational or scientific purposes. Applications for permits may be obtained by writing Mr. Brian Nelson at the above address. Permits are issued free of charge and expire each June 30.

Flower
Elodea canadensis

Seed capsule
Monochoria vaginalis

(From: MONOCOT WEEDS 3. By E. Haflinger, et al. See BOOKS/REPORTS)

BANNED IN FLORIDA

Scientific names	Common names
1) *Alternanthera philoxeroides*	Alligator weed
2) *Cabomba aquatica*	Cabomba
3) *Eichhornia spp.*	Water hyacinth
4) *Hydrilla spp.*	Hydrilla
5) *Ipomoea aquatica*	Water spinach
6) *Lagarosiphon spp.*	African elodea
7) *Ludwigia octovalvis*	
8) *Ludwigia peruviana*	
9) *Maidenia rubra*	
10) *Monochoria hastata*	
11) *Monochoria vaginalis*	
12) *Myriophyllum spicatum*	Eurasian watermilfoil
13) *Najas marina*	Marine naiad
14) *Nechamandra alternifolia*	
15) *Panicum repens*	Torpedo grass
16) *Pontederia rotundifolia*	Tropical pickerel weed
17) *Potamogeton pectinatus*	Sago pondweed
18) *Salvinia molesta*	Giant salvinia
19) *Sparganium erectum*	
20) *Spirodela oligorhiza*	Giant duckweed
21) *Stratiotes aloides*	Water soldier
22) *Trapa spp.*	Water chestnut

BOOKS/REPORTS *Con't. from page 3*

ECOLOGICAL IMPACT OF INTEGRATED CHEMICAL AND BIOLOGICAL AQUATIC WEED CONTROL. by J.V. Shireman, W.T. Haller, D.E. Colle, C.E. Watkins, D.F. DuRant and D.E. Canfield. 1983. Report of the Center for Aquatic Weeds, University of Florida, Gainesville, for the U.S. Environmental Protection Agency, Environmental Research Lab., Gulf Breeze, Florida. 333 pages. NTIS Order No. PB83-264242.

This report discusses the biological and water quality changes which occurred as the abundance of macrophytic vegetation was altered by natural factors and management practices. Macrophyte abundance strongly influenced the structure of communities, and it was concluded that environmental effects of plant management programs are determined more by the amount of vegetation controlled than by management practices used. Also, changes in lake hydrology and rates of nutrient loading appear to be more important as determinants of lake water quality than are macrophytes. Research needs for evaluation of effects of weed control on aquatic systems are identified.

ACID DEPOSITION: CAUSES AND EFFECTS. Proceedings of the March, 1983, Acid Deposition Science Workshop—Causes and Effects, sponsored by the University of Florida. 1983. Government Institutes, Inc., Publisher, 966 Hungerford Drive #24, Rockville, Maryland 20850. 328 pages. $38.00

This is a collection of papers which describe natural and man-made sources of acidic precipitation and its effects on terrestrial and aquatic systems. A couple of the papers relate specifically to aquatic plants. A major goal of the workshop was to formulate long range research goals.

GUIA DE PLANTAS ACUATICAS Y PALUSTRES VALDIVIANAS. by C. Ramirez G., R. Godoy B., D. Contreras F. and E. Stegmaier W. 1982. Central de Publicaciones, Universidad Austral de Chile, Casa 24, Campus Universitario, Valdivia, CHILE. 64 pages. (In Spanish)

This is an identification guide (with key) to the aquatic and shoreline plants which occur in the Valdivianas of Chile. Drawings of 45 plants and their parts are included. Brief sections on the morphology, physiology, life-forms, and zonation and succession are also included.

HARVESTING CATTAIL *(TYPHA SPP)* RHIZOMES AS AN ALTERNATIVE FEEDSTOCK FOR ALCOHOL PRODUCTION: MODIFICATIONS OF POTATO HARVESTER. by C. Schertz, D. Dubbe and D. Pratt. 1983. Final Report of the Bio-Energy Coordinating Office of the University of Minnesota, prepared for the U.S. Department of Energy, Washington, D.C., Alcohol-Fuels Grant Program. Report No. DE83 009726. 21 pages.

Because of cattail's high yield and sugar and starch content, it is a good candidate for commercial alcohol production. The purpose of this project was to produce a device capable of harvesting cattail rhizomes and shoot bases from the substrates in which they grow. They converted an off-the-shelf potato harvester into a cattail rhizome harvester by adding coulters, changing clearances and depth adjustments, and extending the frame. Traction and flotation problems were overcome and a harvesting test on a natural stand of cattail growing on wet mineral soil was judged successful.

AGRICULTURAL CHEMICALS. Book II. Herbicides. 1983-84 Revision. by W.T. Thomson. 1983. Thomson Publications, P.O. Box 9335, Fresno, California, 93791, USA. 285 pages. $13.50.

This manual is one of the Agricultural Chemical Book Series published by Thomson. The manual describes in detail the herbicides used in the world today, and includes experimental materials. The descriptions are grouped into 1) phenoxy compounds; 2) benzoic, acetic acids and phthallic compounds; 3) dinitro analines, nitrites, amides, acetamides and anilides; 4) carbamates; 5) heterocyclic nitrogen derivatives; 6) urea compounds; 7) metal organics and inorganics; and 8) other herbicides. Herbicides are listed according to chemical and common names. For each compound, the company which has done the most work on it is listed, followed by the year the compound was patented or put on the market. Also for each compound, its toxicity, its various market formulations, its phytotoxicity, its uses and use rates, the weeds it controls, its application methods and its related mixtures are described.

BIOCLEANSING WITH AQUATIC WEEDS: A MEANS OF REMOVING ASBESTIFORM FIBERS FROM WATER. by R.M. Pfister. 1980. Report of the Water Resources Center, The Ohio State University, for the U.S. Department of the Interior, Office of Water Research and Technology, Washington, D.C. Report No. 712431. 14 pages. NTIS order no. PB 82-256579.

The purpose of this study was to find a suitable aquatic plant for the removal of asbestos fibers from water supplies, spurred by the presence of amphibole mineral fibers in the drinking water supplies of at least one midwestern USA city which reported 1 million to 100 million fibers per liter of drinking water. Plants used in these aquarium studies were *Elodea, Scirpus, Sagittaria* and *Potamogeton. Elodea* recorded the greatest overall reduction; after four weeks asbestos fibers in the 200 liter aquaria were reduced by as much as 65%. Pondweed in the 200 liter aquaria reduced fiber concentration by as much as 52% after six weeks. *Sagittaria* reduced fiber concentrations by 34% and *Scirpus* achieved an overall reduction of 39%. *Elodea* removes the greatest number of fibers per gram of plant material. It appears that the ability of a plant to scavenge asbestos is directly proportional to the surface area of the plant.

Continued on page 7

TUBERS, TURIONS AND PROPAGULES

Tubers, turions and propagules are names for reproductive parts of some aquatic plants. Below is a selected list of citations retrieved from the database using these keywords:

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SEDIMENT AND GROWTH

The soil on which some aquatic plants grow is a subject of investigation among aquatic biologists. Of special interest to some is the uptake of sedimentary nutrients and their effects on the growth of the aquatic weeds hydrilla, watermilfoil and others. Below is a list of some articles retrieved from the aquatic plant database which combine the keywords "sediment" and "growth".

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TRANSPLANTING

In recent months, this program has received several requests for citations on the establishment of transplanted aquatic plants in freshwater and saltwater areas. Some researchers want to know what plants might be used to re-vegetate spoil areas. Others want to know of experiments for establishing salt marshes and seagrass meadows. The following is a list of selected citations retrieved from the aquatic plant database using the keywords "transplant", "establishment" and "propagation". The list is meagre and we ask users of the database and readers of this newsletter to let us know of research in these areas. Items received will be added to the aquatic plant database and made known to users of the system.

Broome, S.W. The effects of source, rate and placement of nitrogen and phosphorus fertilizers on growth of *Spartina alterniflora* transplants in North Carolina. Estuaries 6(3):212-226; 1983.

Burton, T.M.; D.L. King; R.C. Ball; T.G. Bahr. Utilization of natural ecosystems for wastewater renovation. Institute of Water Research, Michigan State University, East Lansing, Michigan, for U.S. Environmental Protection Agency, Chicago, Illinois; EPA-905/3-79-003; 169 pages; 1976.

Clairain, E.J. et al. Habitat development investigations. Miller Sands marsh and upland habitat development site, Columbia River, Oregon. Summary Report. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Tech. Report D-77-38; 76 pages; 1978.

Darovec, J.E. et al. Techniques for coastal restoration and fishery enhancement in Florida. Florida Department of Natural Resoucres, Marine Research Laboratory, St. Petersburg; Publications No. 15; 27 pages; 1975.

Denson, K.; F. Langford. Expansion of transplanted giant bulrush in Central Florida lakes. Fla. Game Freshwat. Fish Comm., Lakeland; Report; 14 pages; 1983.

Durako, M.J.; M.D. Moffler. Variation in *Thalassia testudinum* seedling growth related to geographic origin. In: Proc. 8th Ann. Conf. Wetlands Restoration and Creation, 8-9 May 1981, Hillsborough Community College, Tampa, pp.100-117; 1981.

Eleuterius, L.N. Transplanting maritime plants to dredged material in Mississippi waters. In: Proc. Symp. Dredging and Its Environm. Effects, 26-28 January 1976, ASCE/Mobile, Alabama; pp.900-918; 1976.

Falco, P.K.; F.J. Cali. Pregermination requirements and establishment techniques for salt marsh plants. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi; Misc. Paper D-77-1; 42 pages; 1977.

Fonseca, M.S.; W.J. Kenworthy. Transplanting of eelgrass and shoalgrass as a potential means of economically mitigating a recent loss of habitat. In: Proc., 6th Ann. Conf. Wetlands Restoration and Creation, 19 May 1979, ed. by D.P. Cole, Hillsborough Community College, Environmental Studies Center and Tampa Bay Authority, Tampa, Florida; 357 pages; pp.279-326; 1979.

Fonseca, M.S.; W.J. Kenworthy; G.W. Thayer. A low-cost planting technique for eelgrass *(Zostera marina* L.). U.S. Army Corps of Engineers, Coastal Engineering Research Center, Fort Belvoir, Virginia; Coastal Engineering Technical Aid No. 82-6, 15 pages; 1982.

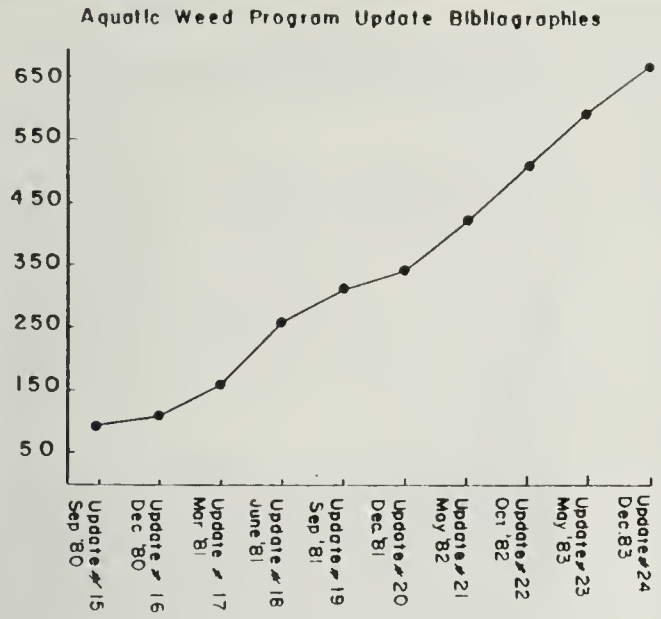
Fonseca, M.S.; W.J. Kenworthy, R.C. Phillips. A cost-evaluation technique for restoration of seagrass and other plant communities. Environm. Conserv. 9(3):237-241; 1982.

Garbisch, E.W.; L.B. Coleman. Tidal freshwater marsh establishment in Upper Chesapeake Bay: *Pontederia cordata* and *Peltandra virginica*. In: Freshwater Wetlands, ed. by R. Good, Academic Press, New York; pp.285-298; 1978.

Haslam, S.M. The development and establishment of young plants of *Phragmites communis* Trin. Ann. Bot. 35:1059-1072; 1971.

Heilman, P.E.; D.M. Greer; S.E. Brauen; A.S. Baker. Habitat development field investigations. Miller Sands marsh and upland habitat development site Columbia River, Oregon. Postpropagation assessment of botanical and soil resources on dredged material. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi; Tech. Report D-77-38; 390 pages; 1978.

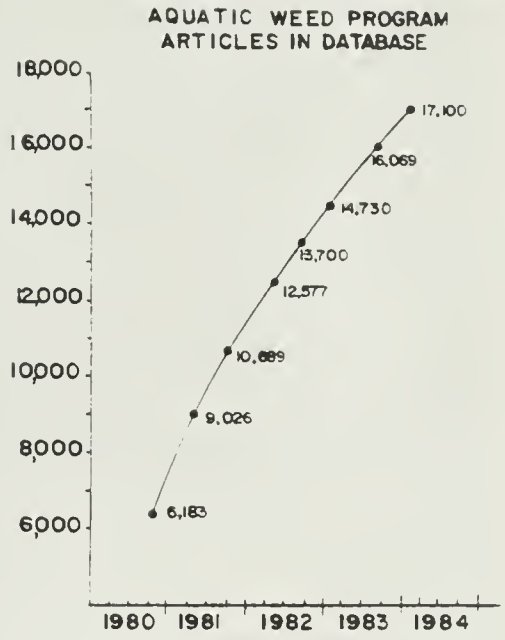
Continued on page 9



The Aquatic Weed Program maintains an information exchange system which is shared by several thousand aquatic plant and ecosystem researchers world-wide. Program users contribute research articles, reports and books and, in return, receive printed lists of citations of articles and books, according to their specific research interests. Citation lists (bibliographies) are requested and produced by computer according to plant species, subject categories and subcategories and keywords of the literature. In this way, researchers keep track of world-wide research in their specialties. This service is provided free of charge by the Aquatic Weed Program.

The graph at the left shows the number of individuals who receive regular updates to their aquatic plant bibliographies. (Several hundred more researchers a year receive one-time "retrospective" searches but do not request regular updates.) The graph at the right shows the number of articles and reports contained in the database whose citations and category/keyword lists are retrievable from the program's computer-based system. Most of these articles and reports have been contributed by users of the system and are on file in the program library.

Identifying, locating and requesting research works from authors, indexing, filing and entering information into the computer system, as well as keeping track of the thousands of library items and pieces of mail sent and received every year by the Aquatic Weed Program, is work done by Karen Brown, Kathleen Culver, Leslie Landry, Alexandria Patterson and Victor Ramey.



Researchers in the following countries share the Information and Retrieval System:

Algeria
Argentina
Australia
Austria
Barbados
Belgium
Botswana
Brazil
Canada
Chile
China (ROC)
China (PRC)
Colombia
Czechoslovakia
Denmark
Egypt
Ethiopia
Fiji
Finland
France
Germany (FRG)
Germany (GDR)
Ghana
Great Britain
Greece
Guyana
Honduras
Hungary
India
Indonesia
Israel
Italy
Japan
Kenya
Korea (S.)
Lebanon
Liberia
Malaysia
Mali
Mexico
Mozambique
Namibia
Netherlands
New Zealand
Nigeria
Panama
Papua New Guinea
Philippines
Poland
St. Lucia
Scotland
South Africa
Spain
Sri Lanka
Sudan
Sweden
Switzerland
Syria
Thailand
U.S.S.R.
Venezuela
West Indies
Yugoslavia

United States:

Alabama
Alaska
Arkansas
California
Colorado
Connecticut
Florida
Georgia
Hawaii
Idaho
Illinois
Indiana
Iowa
Louisiana
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
New Jersey
New York
North Carolina
Ohio
Oregon
South Carolina
South Dakota
Tennessee
Texas
Virgin Islands
Virginia
Washington (St.)
Washington (DC)
West Virginia
Wisconsin

Below is a list of plants most often the subject of searches in the database. Also listed is the approximate number of citations in the database for that plant as of January, 1984:

Plant Name	Articles
Alternanthera philoxeroides	500
Azolla pinnata	150
Brasenia schreberi	130
Cabomba caroliniana	135
Ceratophyllum demersum	800
Eichhornia crassipes	1,700
Elodea canadensis	690
Hydrilla verticillata	650
Juncus effusus	130
Lagarosiphon major	70
Lemna minor	670
Myriophyllum spicatum	780
Najas guadalupensis	250
Nelumbo lutea	100
Nuphar advena	140
Nymphaea odorata	150
Phragmites australis	770
Pistia stratiotes	400
Polygonum amphibium	120
Pontederia cordata	150
Potamogeton pectinatus	650
Ranunculus aquatilis	100
Sagittaria latifolia	170
Salvinia molesta	125
Scirpus validus	150
Spartina alterniflora	350
Spirodela polyrhiza	310
Trapa natans	125
Typha latifolia	570
Utricularia vulgaris	125
Vallisneria americana	180
Wolffia columbiana	100
Zannichellia palustris	160
Zizania aquatica	170
Zostera marina	200

Hundreds more aquatic plant species also are cited in the database.

For more information, contact:
Aquatic Weed Program
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Gainesville, FL 32611 USA
(904) 392-1799

BOOKS AND REPORTS

Continued from page 4

SALINITY-PRODUCTIVITY RELATIONSHIPS OF SELECTED PLANT SPECIES FROM THE SUISUN MARSH, CALIFORNIA. by R.W. Pearcy, D.E. Bayer and S.L. Ustin. 1982. Report of the Department of Botany, University of California, Davis, for the California Water Resources Center, Davis, and the U.S. Department of the Interior, Washington, D.C. 58 pages. NTIS Order No. PB83-154450.

The influence of salinity on the productivity of *Scirpus robustus, Spartina foliosus, Salicornia virginica,* and *Cotula cornupifolia* were examined. Laboratory measurements of growth, photosynthetic responses and competitive interactions, and field measurements of water relations, growth and carbohydrate reserves were made. The studies were conducted primarily to establish management criteria (especially salinity control) for the Suisun Marsh which is a major stopover on the Pacific Flyway and important to waterfowl. *Scirpus robustus* is a major waterfowl food.

INTERACTIVE INFLUENCES OF LIGHT AND TEMPERATURE ON THE GROWTH AND MORPHOLOGY OF SUBMERSED FRESHWATER MACROPHYTES. by J.W. Barko, D.G. Hardin and M.S. Matthews. 1984. Technical Report A-84-3. Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi, 39180, USA. 24 pages.

Variations in the growth and morphology of *Elodea canadensis, Potamogeton nodosus* and *Vallisneria americana* were investigated in relation to various ranges of light and temperature. Response variables considered included biomass production, shoot density and length, and leaf forms. The investigators concluded that light and temperature over broad ranges have equal importance in influencing the growth and morphology of these submersed plants. They discussed the morphological and physiological adaptations of these plants and their subsequent ability to displace other plants.

Continued on page 10

CENTRAL AND SOUTH AMERICAN RESEARCHERS CONTRIBUTE TO PROGRAM

A primary goal of the Aquatic Weed Program is to act as an information exchange agency for aquatic plant researchers. In the past year, almost 2,000 articles, books and reports have been contributed to the program by its users. Contributions are cataloged and added to the database, and are included in the computer-generated bibliographies produced for our users.

Researchers in South America and Central America also contribute their work to the Aquatic Weed Program. Their countries must deal with serious aquatic weed problems: reservoirs evaporate, turbines clog, irrigation systems become inefficient, rivers overflow, mosquitoes thrive, diseases spread.

Their research ranges from identifying insects on aquatic plants which may be used as biological controls, to devising biomass estimation techniques, to studying the effects of herbicides in untested environments, to studying *Azolla* as a biofertilizer in rice, to inventing unusual biogas generation units using aquatic weeds as stock, just to name a few of their research fronts. Reports of their works have increased greatly.

Listed below are names of some South and Central American institutions and corporations which have shared in the Aquatic Weed Program's information exchange.

ARGENTINA
Asociacion de Ciencias Naturales del Litoral
Jose Macia 1933
3016 Santo Tome
Santa Fe

Catedra de Ecologia General
Facultad de Ciencias Naturales y Museo
Instituto de Limnologia
Universidad Nacional de La Plata
Paseo del Bosque s/n
1900 La Plata

Centro de Estudios Fotosinteticos y Bioquimicos (CEFOBI)
Universidad Nacional de Rosario
Suipacha 531
2000 Rosario

Centro de Recursos Naturales
Universidad Nacional del Sur
8000 Bahia Blanca

Estacion Experimental de Gorina
Ministerio de Economia
Subsecretario de Asuntos Agrarios
1896—J. Gorina
Buenos Aires

Estacion Experimental Delta del Parana
Instituto Nacional de Tecnologia Agropecuaria (INTA)
Ministerio de Agricultura y Ganaderia
2804 Campana

Estacion Experimental Regional Agropecuaria Salto
Institute Nacional de Tecnologia Agropecuaria (INTA)
Secretaria de Estado de Agricultura y Ganaderia de la Nacion
4.400—Salta

Instituto de Botanica Darwinion
Academia Nacional de Ciencias Exactas, Fisicas y Naturales
Labarden 200
Casilla Correo 22
1642 San Isidro

Instituto de Investigaciones Bioquimicas
60 y 120
1900 La Plata

Instituto Nacional de Limnologia (INALI)
Laboratorio de Macrofitas
Jose Macia 1933
3016 Santo Tome
Santa Fe

Museo de Ciencias Naturales del Chaco
Provincia del Chaco

BRASIL
Centro de Energia Nuclear na Agricultura
Secao de Microbiologia do Solo
U.S.P.
Piracicaba
Sao Paulo

COPASA MG
Rua Sergipe, 580 Rua Carangola, 500
30.000 Belo Horizonte
Minas Gerais

EMBRAPA
Centro Nacional de Pesquisa—Arroz, Feijao
Caixa Postal, 170
Golania—Go. 74.000

Fundacao Universidade do Rio Grande
Caixa Postal 474
96200 Rio Grande R.S.

Grupo de Estudos de Poluicao
GEP/CAESB
SCS Q.4
Conj. "A" Nos. 67/97
Brasilia

Instituto Agronomico
Avenida Barao de Itapura, 1481
Caixa Postal 28
13.100 Campinas
Sao Paulo

Laboratory of Aquatic Ecology
Nucleo de Fontes Nao Convencionais de Energia
Universidade Federal do Ceara
Caixa Postal 1391
6000 Fortaleza
Ceara

Universidade Federal de Vicosa
36570 Vicosa MG

Ministerio da Marinha
Instituto de Pesquisas da Marinha
Rio de Janeiro

Secretaria de Estado dos Negocios
de Agricultura e Abastecimento
Coordenadoria da Pesquisa de Recursos Naturais
Instituto de Botanica
Caixa Postal 4005
01000 Sao Paulo, S.P.

Superintendencia dos Recursos
Hidricos e Meio Ambiente (SURHEMA)
Rua Eng. Reboucas 1.206
80.000 Curitiba—Parana

Universidade Estadual Paulista
Campus de Jaboticabal
Faculdade de Ciencias Agrarias e Veterinarias
14.870 Jaboticabal
Sao Paulo

Universidade Federal de Pelotas
96.100 Pelotas

CHILE
CIDERE BIOBIO
Anibal Pinto 372
Oficina 72
Casilla 2177
Concepcion

Universidad Austral de Chile
Instituto de Botanica
Casilla 567
Valdivia

COLOMBIA
Empresa Colombiana de Petroleos (ECOPETROL)
Complejo Industrial de Refinacion y Petroquimica
Barrancabermeja

Fundacion Universidad de Bogota
Seccional Del Caribe
Apartado Aereo 1310
Cartagena

Instituto Colombiano Agropecurio (ICA)
Apartado Aereo No. 7151123
Apartado Postal No. 3413
Bogota, D.E.

COSTA RICA
Departamento de Acuaculture
Ministerio de Agricultura y Ganaderia
San Jose

Estacion Experimental Agricola
Fabio Baudrit Moreno
Apartado Postal 183
Alajuela

Universidad Nacional
Escuela de Ciencias Agrarias Heredia

CUBA
Industrial Research Group
Apartado 189
Ciudad de la Habana 1

ECUADOR
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Instituto Nacional de Investigaciones Agropecurias (INIAP)
12 km carretera a Santa Ana, al Sur de Portoviejo
Casilla Postal 100
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Estacion Experimental Boliche
Instituto Nacional de Investigaciones Agropecurias (INIAP)
P.O. Box 7069
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EL SALVADOR
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Ministerio de Agricultura y Ganaderia
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GUYANA
National Science Research Council
University Campus
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Greater Georgetown
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Georgetown

The University of Guyana
Faculty of Natural Sciences
Turkeyen Campus
Box 101110
Georgetown

HONDURAS
Escuela Agricola Panamericana
Tegucigalpa

Servicio Autonomo Nacional de Acueductos y Alcantarillados
Apdo. Postal No. 437
Tegucigalpa

JAMAICA
Plant Protection Division
Ministry of Agriculture
Hope Gardens
P.O. Box 480
Kingston 6

MEXICO
Centro de Estudios Limnologicos
Apdo. Postal 32
Tlaquepaque
Jal. 45500

Direccion General de Acuacultura
Alvaro Obregon No. 269-7 Piso
Mexico 7, D.F.

Instituto de Biologia UNAM
Departamento de Botanica
Apartado Postal 70-233
Delegacion de Coyoacan
04510 Mexico, D.F.

Secretaria de Agricultura y Recursos Hidraulicos
Instituto Nacional de Investigaciones Agricolas
Apartado 6-882 y 6-883
Mexico 6, D.F.

Dirreccion General de Usos del
Agua y Prevencion de la Contaminacion
Subdireccion de Investigacion y Entrenamiento
Oficio Nu. 241.1.2.5
Mexico, D.F.

Universidad de Chiapas
Ciencias Quimicas
Apartado Postal 594
Tapachula
Chiapas 30700

Universidad del Noreste
Escuela de Ciencias Biologica
Carretera Tampico-Mante Km.137
Apdo. Postal 1479
Tampico, Tam.

NICARAGUA
EDUCREDITO
Centro INDE
Apartado 2598
Managua

PANAMA
Instituto de Investigacion Agropecuria de Panama
Apartado 58
Santiago, Veraguas

ST. LUCIA
Caribbean Agricultural Research
and Development Institute (CARDI)
The Ministry of Agriculture
Box 971
Castries

VENEZUELA
Universidad de Los Andes Trujillo
Universidad Nacional Experimental de los Lianos Occidentales
Ezequiel Zamora
Universidad que Siembra
Guanare 3310
Portuguesa

LIMNOLOGIST
Continued from page 2

(nutrient) conditions, some trophic states were predicted to be more affected by macrophytes than others.

Canfield says one of the next steps in developing an ecosystem model is to quantify the effects of macrophytes on fish and other fauna of the aquatic ecosystem. Canfield, and others at the Center for Aquatic Weeds and elsewhere, will continue collecting the basic information necessary to develop a unified aquatic ecosystem model.

V. Ramey

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University of Florida
Gainesville, FL 32611
(904) 376-0732

Below is a selected list of citations of Canfield's work.

Canfield, D.E.; M.J. Maceina; L.M. Hodgson; K.A. Langeland. Limnological features of some northwestern Florida lakes. J. Freshwater Ecol. 2(1):67-79; 1983.

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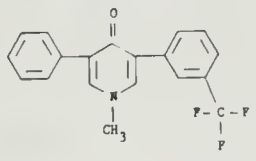
FLURIDONE, BRAKE, SONAR, COMPEL, EL-171, PRIDE



1-Methyl-3-phenyl-5-(3-trifluoromethyl) phenyl)4(1H) pyridinone

From: *Agricultural Chemicals* by W. T. Thompson
See BOOKS/REPORTS

CHILE CORPORATION AND AQUATIC WEEDS

CIDERE Biobio (Chile) is a national corporation whose objective is to accelerate the development of the use of natural resources and industrial waste in the Biobio region of Chile. Their goal is to utilize these resources through simple techniques carried out by the unskilled population of the region.

Recent projects and accomplishments include one dealing with aquatic weeds. According to a report, water hyacinth has invaded many square miles of their waterways. As part of their committment to utilize their natural resources, they are attempting to make food out of the pest plant by ensiling it. Ensiling and palatability tests are under way, and soon, water hyacinths may become part of the regular diet of Chilean cattle.

Other CIDERE projects include the gasification of wood chips, the waste product of forest projects; the use of wild vegetable fibers in the textile industry; the reclamation of silver from waste solutions of the photography industry; and the development of a 100 cubic meter anaerobic digester which daily generates 3 cubic meters of biofertilizer and 100 cubic meters of combustible biogas.

For further information about CIDERE Biobio, write Mr. Juan Raffo S., General Manager, CIDERE Biobio, Anibal Pinto 372, Casilla 2177, Concepcion, CHILE.

TRANSPLANT *Con't. from page 6*

Homziak, J.; M.S. Fonseca; W.J. Kenworthy. Macrobenthic community structure in a transplanted eelgrass *(Zostera marina)* meadow. Mar. Ecol. Prog. Ser. 9:211-221; 1982.

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PLANT IDENTIFICATION SERVICE

The University of Florida Herbarium is operated by the Florida State Museum Department of Natural Sciences and is located on the University of Florida campus in Gainesville. Among the services provided by the Herbarium is the plant identification service. Dr. David Hall is Extension Botanist for the Herbarium and identifies aquatic and terrestrial plant specimens sent him in the mail. According to Dr. Hall, the Herbarium has an extensive library and plant collection on the flora of Florida and the Southeastern United States and will identify plants found in these areas. He suggests those in other areas of the world should contact local and national herbaria for plant indentification.

For a botanist to make accurate identification of plants, the plant should be packed correctly before being sent to the herbarium. Dr. Hall says that plants, including aquatic plants, should be placed flat on a pasteboard or cardboard, or placed into a section of newspaper. Under no circumstances should plant specimens be placed in plastic bags, because plastic retains water and facilitates the more rapid decay of the plant. In plastic, the plant usually turns into an unrecognizable goo during several days of transit. Choose the fastest possible means of delivery to the herbarium.

Herbaria botanists look at such characteristics as flower, leaf and fruit color, shape and size. Stems, hairs and roots are also examined during the classification process. Dr. Hall says the process is made easier if the sender describes the color of the flower, and the shape of the fruit, because during shipment, color fades and fruits are pressed out of shape. Comments such as "Flower is dark red, fruit is oblong with hairs" greatly aids the botanist in his task. Other information essential for herbaria botanists is the location of the specimen's habitat and a description of the habitat, in relation to major landmarks which would appear on maps. For example, "Specimen was found beside a ditch, in a regularly flooded area, 6 miles west of Opptown, on highway 63, 100 yards east of the Greater Opptown bridge" enables the botanist to locate the site on maps, which is very important.

Finally, the sender should include his name, address and phone number inside the package, as well as on the outside.

Dr. Hall and the University of Florida Herbarium can be contacted at: The Herbarium, 209 Rolfs Hall, University of Florida, Gainesville, Florida 32611, USA.

V. Ramey

INTERNATIONAL SYMPOSIUM ON BIOLOGICAL CONTROL OF WEEDS

The VI International Symposium on Biological Control of Weeds will be held on 19-25 August, 1984, at the University of British Columbia, Vancouver, Canada. Details of the meeting are in a previous issue of AQUAPHYTE.

The conference will include the presentation of research results on a variety of biocontrol topics, as well as field trips in the Vancouver area. For more information, contact: Dr. Judith H. Myers, I.A.R.E., 2075 Wesbrook Mall, University of British Columbia, Vancouver, British Columbia, CANADA V6T 1W5.

ARNOLDIA

ARNOLDIA, published quarterly by the Arnold Arboretum of Harvard University devoted its Spring 1983 issue to aquatic and wetland plants of the Arnold Arboretum, and featured an article on the biology of aquatic plants by P.B. Tomlinson.

The plants were described by P.A. Daalton and A. Novelo R. Very fine line drawings of the plants by A.C. Storey are included.

Copies of the issue (Vol. 43, No. 2, Spring 1983) are available from: **ARNOLDIA**, The Arnold Arboretum, The Arborway, Jamaica Plain, Massachusetts 02130 U.S.A.

WATER HYACINTH BOOK

Dr. Brij Gopal is preparing an extended updated monograph on water hyacinth. He would appreciate receiving reprints of publications (also in languages other than English) and/or any information on distribution, recent spread, control and utilization of water hyacinth in all regions. Dr. Gopal can be contacted at: Geobotanical Institute of ETH, Zurichbergstrasse 38, CH-8044 Zurich, SWITZERLAND.

BOOKS AND REPORTS

Continued from page 7

WEED CONTROL IN RICE. Proceedings of the Conference, 31 August—4 September 1981, Los Banos, Philippines. Sponsored by the International Rice Research Institute and the International Weed Science Society, edited by W.H. Smith. 1983. International Rice Research Institute, P.O. Box 933, Manila, Philippines. 422 pages.

This is a collection of the forty papers presented at the conference. The papers discuss weeds of major economic importance in rice production, their biology and ecology, and their control technologies used throughout the world. Each paper is followed by a discussion of it.

RHEOPHYTES OF THE WORLD, An Account of the Flood-resistant Flowering Plants and Ferns and the Theory of Autonomous Evolution. By C.G.G.J. Van Steenis. 1981. Sijthoff and Noordhoff, The Netherlands. 407 pages.

"By definition rheophytes are plant species which are in nature confined to the beds of swift-running streams and rivers and grow there up to flood-level, but not beyond the reach of regularly occurring flash floods." The book is divided into 12 sections, including those on rheophyte habitat, morphology and ecology, global distribution, cultivation and evolution. The "Census of the Rheophytes of the World" is the final section and has been arranged alphabetically in three phyla, the ferns, the conifers and the flowering plants. For each species listed, the original publication is listed, its synonyms are listed, a concise description of its habit and vegetative characters is given, and its geographical range is described. Some photographs and drawings illustrate plants and habitats.

RIVER PLANTS—THE MACROPHYTIC VEGETATION OF WATERCOURSES. by S. M. Haslam. Illustrated by P. A. Wolseley. 1978. Cambridge University Press, Cambridge. 396 pages.

This book concerns the plants of British and some North American rivers, streams and channels. Some chapters deal with effects of flow characteristics and substrates on plants and their distributions within a stream. Other chapters discuss effects of stream width and slope, effects of water speed, depth, etc., effects of shading and light, effects of nutrient concentrations and distribution and effects of pollution on river plants. An illustrated guide for the 80 most important species is also included.

AQUATIC WEED PROGRAM
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Dr. Marianne Block
Serials and Exchange
The New York Botanical Garden
Bronx, New York 10458

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Center for Aquatic Weeds

AQUAPHYTE

International Plant Protection Center
AQUATIC WEED PROGRAM

VOLUME 4 NUMBER 2 GAINESVILLE, FLORIDA FALL 1984

WALT DISNEY WORLD: METHANE FROM WATER HYACINTH

Among the futuristic technological achievements at Walt Disney World (Orlando, Florida) one is not seen by the general public: an experimental system which integrates a water hyacinth wastewater treatment process with a methane production facility. In the system, some wastewater from the attraction's theme parks is cleansed by the action of water hyacinths, which are subsequently harvested and fed to a sophisticated anaerobic digestor for the production of usable methane. The project is sponsored by the Gas Research Institute (GRI) and according to them, "this research is expected to benefit the gas consumer and the public at large by providing local sources of pipeline-quality gas." Results here may lead to the construction of commercial full-scale water hyacinth utilization facilities in the late 1980s.

The first part of the system is the hyacinth secondary and tertiary wastewater treatment process. After some solids have settled out as sludge in the "primary clarifier", the water is diverted to concrete channels where the plants are cultured. Here, the plants remove unwanted nutrients and other pollutants, while complex organic wastes are broken down to simpler compounds by the bacteria which live on the water hyacinths. These simpler waste compounds are then utilized by the growing hyacinths. Under these conditions, the hyacinths grow luxuriantly.

continued on page 4

INTERNATIONAL SYMPOSIUM ON AQUATIC MACROPHYTES

Danish institutions for research in aquatic ecology have planned a symposium on aquatic macrophytes in Silkeborg, Denmark, 26-30 August, 1985. The symposium will focus on the physiology and ecology of submerged macrophytes. The three main topics for the symposium are: 1) Regulation of carbon metabolism through photosynthetic fixation and respiratory losses, 2) Regulation of field growth rates by internal and external variables, and 3) The effect of submerged macrophytes on ecosystem functioning in macrophyte dominated systems.

Four days will be used for scientific presentations and discussion and one day for excursion in Jutland, Denmark's lake district. Full hotel accomodations including all meals will range from about 2,400 D.kr. ($240.00) to 2,650 D.kr. ($265.00). The symposium registration fee is 500 D.kr. ($50.00).

For additional information, registration forms, hotel reservations, etc., contact the Secretary, **Dr. Morten Sondergaard, Botanical Institute, University of Aarhus, Nordlandsvej 68, 8240 Risskov, DENMARK.** Others on the organizing committe are **Dr. Kaj Sand-Jensen of the University of Copenhagen Freshwater Biological Laboratory, and Dr. Niels Thyssen of the National Agency of Environmental Protection Freshwater Laboratory.**

FLORIDA ENACTS WETLANDS PROTECTION LAWS

The 1984 Florida Legislature passed statutes which legally define and are expected to help conserve the State's remaining wetlands. The "Warren S. Henderson Wetlands Protection Act of 1984" (F.S.S. Chapter 403, part VIII) created a vegetative indicator index to use in defining wetlands and also empowered the Florida Department of Environmental Regulation to approve or deny mandatory permits for various operations in wetlands. Approval or denial is to be based on the expected impact of proposed operations on entire wetland ecosystems, including water quality and wildlife. The Act is the product of cooperative work of developers, farmers, ranchers, foresters and conservationists, and became law on October 1, 1984. The DER received $1.1 million and 18 new staff positions to implement the new law in its first year.

The Act defines the extent of wetlands according to vegetative dominance of wetland indicator plants. A list of more than 250 wetland indicator species is included with the Act. An area with a certain percentage cover (depending on plant stratum) of an indicator plant will be considered a wetland. Any dispute about vegetative dominance will be resolved by soil analysis of the area and the presence of hydric soils will indicate the area is a wetland.

Those with permits to operate in wetlands, according to the Act, will not violate water quality

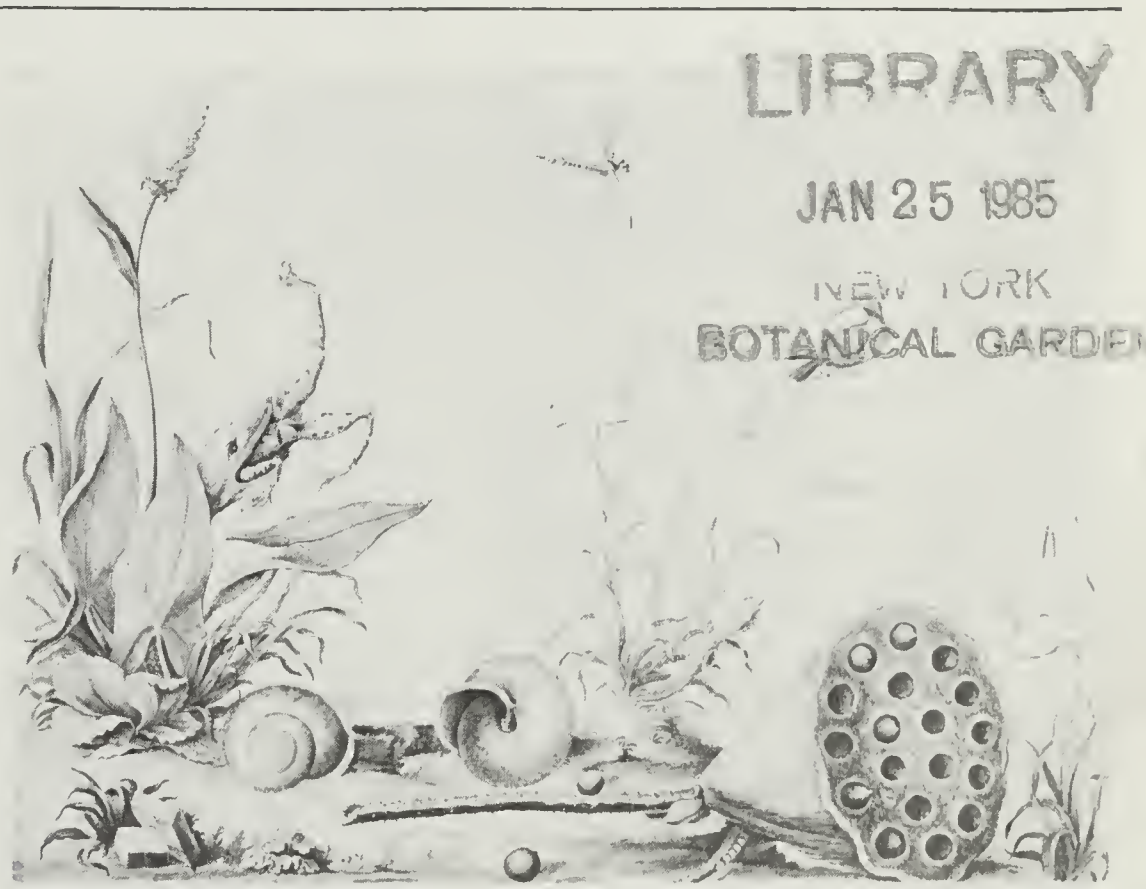
continued on page 2

RETIRING? MOVING? PLEASE DON'T THROW IT AWAY!

The Aquatic Weed Program will be happy to accept your reprints, books and reports. ANYTHING ABOUT ANYTHING about aquatic plants will be cataloged and entered into the Aquatic Plant Database and made available to your fellow researchers in 63 countries. Contact The Aquatic Weed Program, 2183 McCarty Hall, University of Florida, Gainesville, Florida 32611, USA. (904) 392-1799.

WETLANDS RESTORATION AND CREATION

The 12th Annual Conference on Wetlands Restoration and Creation will be held on May 16-17, 1985 in Tampa, Florida. This forum on research in the restoration, creation and management of freshwater, estuarine and marine wetland systems includes sections on marsh, mangrove and seagrass restoration; mitigation, permitting and regulatory policies; mine reclamation, and management techniques. For more information, contact Mr. Fred Webb, Hillsborough Community College, Plant City Campus, 1206 North Park Road, Plant City, Florida 33566, USA. (813) 754-1561.



William Bartram's illustration of plants and animals from Florida, showing *Pistia stratiotes,* the rosulate-leaved plant on the left side of the plate. *(See Story, page 6)*

NEW THREATS INVESTIGATED IN FLORIDA

by Deborah White, University of Florida Center for Aquatic Weeds

A stand of one of the world's worst weeds has established itself on the margins of Little Lake Bonnet in Highlands County, Florida. The spiny plant forms impenetrable thickets up to 12 feet tall and biologists are concerned that it may spread into other Florida wetland and aquatic habitats, becoming economic liabilities to public and private agencies. The plant, *Mimosa pigra var. pigra*, can take over aquatic and terrestrial sites, prevent access to water supplies by man and beast and in some countries has filled up water channels by as much as 40%. Based on the plant's world-wide reputation as a serious pest, *Mimosa pigra var. pigra* was included on the federal noxious weed list (7CF Part 360) published in June, 1984

The *Mimosa* infestation was described by the author during aquatic plant surveys during the summer of 1984. The surveys were conducted to identify infestations of recognized pest species that reportedly occur in Florida and to determine the distribution and size of aquatic plant populations of certain lakes. Pest species found were cultured for growth and salinity studies and for herbicide trials. Some of the species located and studied in Florida include *Mimosa, Cyperus papyrus, C. alternifolius, Leersia hexandra, Paspalum paspalodes* and *Ludwigia uruguayensis*. Introduction of these plants into Florida has been through natural dispersion (for examples, *Ludwigia uruguayensis* and *Paspalum paspalodes*) and as escapes from aquaria. Others are sold as ornamental plants. This research was supervised by Dr. William T. Haller and sponsored by the USDA/ARS Cooperative Agreement.

Because these species have become naturalized in Florida, it is important to assess their growth potential by monitoring their biological success, both reproductive and vegetative. Although these plants have been very successful and are considered weeds in other areas of the world, their success potential is unknown in Florida, where they may be limited by pathogens and other ecological conditions. Information obtained through our studies can be important not only for developing controls for Florida populations, but also may be significant to control strategies in other countries, especially if biological control agents are discovered.

Despite the recognition of *Mimosa pigra* as a serious pest, its biology is not fully known and its controls only now are being researched. The plant is so new to Florida that even aquatic specialists must learn to recognize it. (See drawing) Distinctive characteristics of this leguminous shrub are its "sensitive" bipannate leaves (folding upon touch), recurved prickles and spines on arching stems, an axillary globose inflorescence and flat brown legume composed of hairy seeds appearing as transverse sections. The seed morphology is ideal for efficient wind, water and animal dispersal. This mechanism, combined with *Mimosa*'s ability to rapidly colonize exposed, disturbed soils, insures the continued success of this species. Some research has shown glyphosate and fosamine to be effective controls; manual controls are ineffective. Recently, education programs, biological control research and integrated management schemes have begun. For more information about *Mimosa*, write to **MIMOSA BULLETIN, Center for Aquatic Weeds, 7922 N.W. 71st Street, Gainesville, Florida 32606, USA.**

Mimosa pigra in Florida

Another exotic plant found in Florida, *Cyperus papyrus* (Egyptian paper plant), has been an overwhelming pest of African lakeshores and rivers. Both this sedge and *Cyperus alternifolius* (umbrella sedge) are popular ornamentals in central and south Florida. Although they both have established along Florida waters, they have not formed the unmanageable floating mats that are their characteristic growth habit in tropical Africa. However, these plants do form large, dense clumps and, aided by their ability to produce runners, compete with native species for shoreline or any open area that is seasonally flooded. Continued monitoring of these populations will help determine what, if any, control measures should be applied.

Other species still are being studied but they are likely to be localized problems only and probably will not become a threat to Florida's environment. We will continue to collect information on the distribution of populations and the biology of these and other aquatic species introduced into Florida.

WETLANDS, *Continued from page 1*

standards, will not adversly affect conservation of fish and wildlife or their habitats, will not adversly affect navigation or water flow or cause erosion, will not adversly affect fishing or recreational values or marine productivity and will not adversly affect significant historical or archaeological resources.

In the case of "agricultural activities", the State's Water Management Districts have been directed to construct and operate "agricultural water management systems" which generally will be exempt from water quality standards. However, the "impact of agricultural water management systems on groundwater quality shall be regulated by water management districts."

The Act also states that 'it is the intent of the legislature' to utilize certain wetlands as natural means of stormwater managment and also as areas for tertiary domestic wastewater treatment.The DER is developing rules for these intents of the legislature.

The DER and Water Management Districts are directed by the Act to establish a central wetlands monitoring system to keep records relating to wetlands utilization, development, conservation and loss throughout Florida.

The Act also gives the DER additional authority to regulate the mining of peat in Florida and requires miners to restore mined areas.

Copies of the Wetlands Protection Act can be obtained from the Information Office, Department of Environmental Regulation, State of Florida, 2600 Blair Stone Road, Twin Towers Office Building, Tallahassee, Florida 32301, USA

ASOCIACION ARGENTINA DE LIMNOLOGIA

This is a newly formed (March, 1984) and comprehensive association of limnological specialists from throughout Argentina, numbering several hundred. The aims of the AAL are to promote scientific exchange and discussion about limnological research through meetings and symposia, publish a Periodical Bulletin, encourage and assist aquatic ecosystem managers, and to maintain a directory of Argentine limnologists.

All aspects of limnology are represented in its membership including ecology, biology, and taxonomy for all groups of plant and animal species of aquatic environments, and includes specialists in such areas as water quality and sedimentology. The elected Directive Committee includes President Juan A. Schnack, Vice-President Juan C. Paggi, Secretary Estela C. Lopretto and Treasurer Alberto Rodrigues Capitulo

The Asociacion has published a *Directory of Argentine Limnologists*, a listing of its members, their areas of scientific specialty, their institutional affiliations and their addresses.

Annual subscriptions are A $400 for Argentine members and US $10 for foreigners. Other information can be obtained by writing, **Asociacion Argentina de Limnologia, Av.Angel Gallardo 470, 1405 Buenos Aires, Argentina.**

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AQUAPHYTE is the newsletter of the Center for Aquatic Weeds and the IPPC Aquatic Weed Program of the University of Florida Institute of Food and Agricultural Sciences (IFAS). The International Plant Protection Center (IPPC) is a unit of Oregon State University and is funded by the United States Agency for International Development (AID). Support for the Aquatic Weed Program also is provided by the Florida Department of Natural Resources (DNR).

EDITOR: Victor Ramey

AQUAPHYTE's circulation is 4,000. It is distributed to aquatic biologists and agencies in 65 countries. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

WILDLIFE AND WATER MANAGEMENT CAN BE COMPATIBLE

Water control systems in Europe have been dug and re-dug since at least Roman times to contain and channel flood waters, to irrigate agricultural areas and to float barges for commerce. These channels always seem to be straight, their sides paved, or barren. They may look good to engineers, who look for maximum this and minimum that. Conservationists, though, appreciate canal mathematics less than engineers, and notice more the elimination of wetland wildlife habitats which are being drained by these water carriers.

In Great Britain, water managers and wildlife conservationists recently have joined to find ways to "integrate nature conservation" into the design of water control systems. Alarmed by their country's rapid loss of wetlands and wildlife, the Nature Conservancy Council (the government body which promotes nature conservation) and others have decided that it is time to "shift from management that disregards wildlife and its needs, to management that achieves the same ends but takes the needs of wildlife into account."

At the 24th annual meeting of the **Aquatic Plant Management Society** (15-18 July 1984, Richmond, Virginia), delegates heard from their keynote speaker that water management channels do not necessarily have to be straight and unvegetated to be effective. According to Dr. T.O. (Dale) Robson, new channel designs can help restore wildlife habitats where wetlands have been drained, and vegetated banks can be more recreationally useful and more aesthetically pleasing. Robson says these new channels are efficient as flood control, irrigation and transportation systems, and cost little or no more to construct than older designs.(see diagrams) For more information, see *Nature Conservation and River Engineering* by C. Newbold, J. Purseglove and N. Holmes, 1983, published by Nature Conservancy Council, Attingham Park, Shrewsbury, SY4 4TW, U.K.

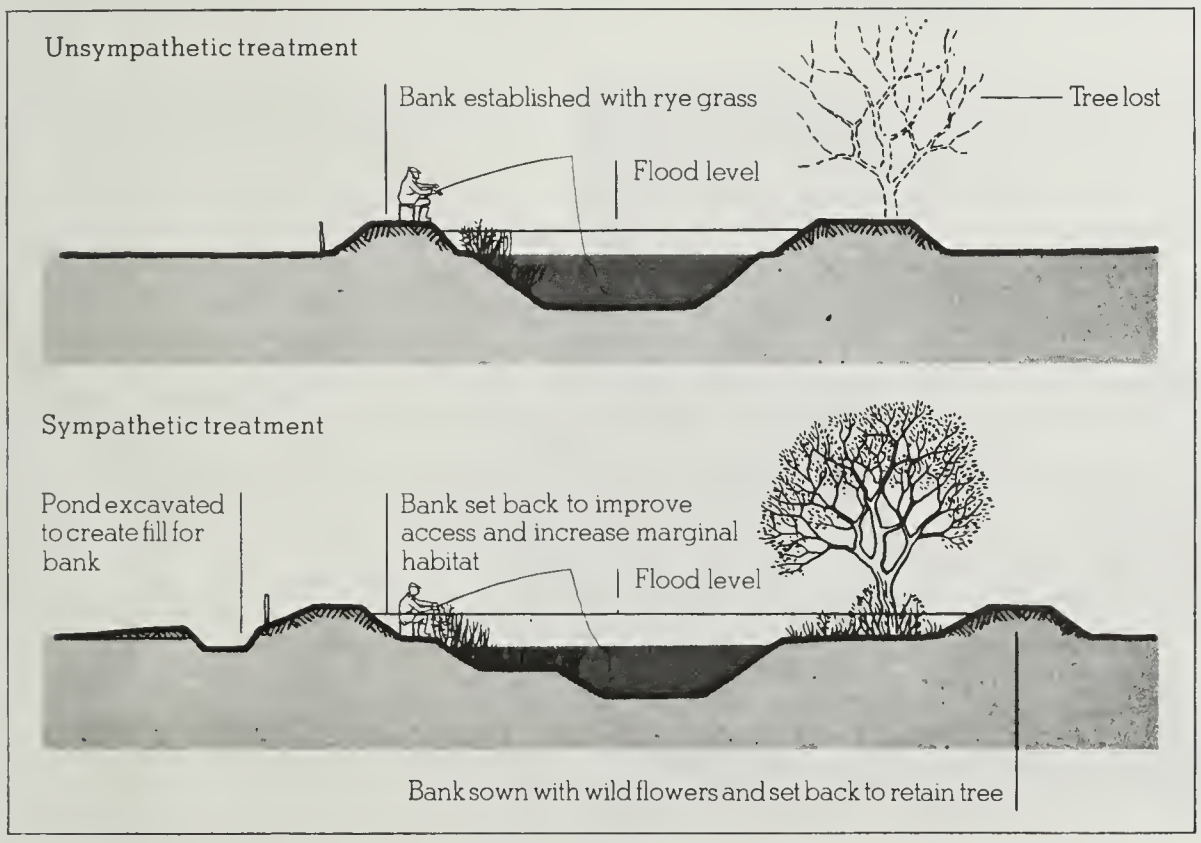
APMS Presidential Award

Dr. Robson is an expert in aquatic weed control, and for years has evaluated the use and efficacy of herbicides and other weed controls in water management systems. He recently retired from the Weed Research Organization in Oxford. (see *EWRS Research Group on Aquatic Weeds* elsewhere in this issue) In recognition of his contributions to the field of aquatic weed control, Robson was presented the APMS Presidential Award by A. Leon Bates. This was the first time this honor was conferred in the history of the APMS.

Other APMS News

Nearly 60 papers were presented at the recent APMS annual meeting in Richmond to an international audience. According to President Leon Bates and Dr. Max McCowen, program chairman, more people had submitted papers this year than in any previous year. Papers this year emphasized the latest discoveries about the biology and methods of control of the problem plants watermilfoil, water hyacinth and hydrilla. (Delegates also saw first hand that hydrilla has now spread to the Potomac River and even graces the Capitol's reflecting pool in Washington, D.C.) Grass carp also was discussed, and of particular interest was its complete control of hydrilla in Lake Conroe, Texas, as reported by R.D. Martyn, R.L. Noble and P.W. Bettoli. Other papers described the ecological effects of fluridone and endothall, the use of wetland plant communities as a means of wastewater treatment, the potential of some newly introduced plants also to become pests, *Eleocharis* as a source of allelopaths for controlling hydrilla and *Potamogeton pectinatus*, the effects of environmental factors on the activity of copper-based algicides, and growth requirements for certain algal species.

Dr. Max McCowen was sworn in as the new APMS president, and next year's program is being organized by Dr. Lars Anderson, president-elect. Secretary-Treasurer William N. Rushing again will handle the meeting's essential arrangements in Vancouver, British Columbia, and we all look forward to another excellent conference. For more information about the Aquatic Plant Management Society, contact Mr. Rushing at P.O. Box 16, Vicksburg, Mississippi 39180, USA.



MEXICAN AGENCY STUDIES AQUATIC WEEDS

by Dr. J. Gualberto Limon M., Centro de Estudios Limnologicos, Secretaria de Agricultura y Recursos Hidraulicos, Apdo. Postal 32, San Pedro Tlaquepaque, 45500 MEXICO

The main purpose of the Centro de Estudios Limnologicos (CEL) is to assess the state of Mexican lakes and to develop guidelines for their management, conservation and restoration. CEL is a federal research centre of Mexico under the Secretaria de Agricultura y Recursos Hidraulicos and is located between Guadalajara and Lake Chapala, the largest Mexican natural lake.

Since a frequent problem of our lakes is macrophyte infestation, a research office at CEL has been charged with investigating the control of aquatic weeds. Currently the most troublesome aquatic plants in Mexico include *Eichhornia crassipes, Potamogeton* spp., *Typha* spp. and *Hydrilla verticillata*. They are widely distributed, except *Hydrilla* which is found mostly in the northeast of Mexico. Another program of this office is to form a "Herbarium of Mexican Aquatic Plants". As of now, we have collected 683 specimens, comprising 163 species.

Part of CEL research has been the evaluation of the grass carp (*Ctenopharyngodon idella*) as a biological control agent for our most troublesome submerged macrophytes. Since grass carp is considered a valuable protein source in some countries, utilization of the fish as a biocontrol in Mexico could be doubly beneficial. In our first stage laboratory tests, food preferences of grass carp for local waterweeds were determined. These tests showed significant potential of grass carp for the control of *Potamogeton filiformis*. Subsequently, grass carp have been used successfully to control *P. filiformis* in irrigation canals.

Another area of our research is the biological control of water hyacinth. With the cooperation of the United States Department of Agriculture and University of Florida laboratory at Fort Lauderdale, Florida, the water hyacinth weevil (*Neochetina eichhorniae*) has been imported into Mexico. After having successfully completed specificity tests with our local plants of both economic and ecological importance, we are now in the final stages prior to its large scale release.

Because CEL is interested in expanding its research on water weeds, I made a two-week visit to Florida to obtain updated information on the control of aquatic plants. My technical visit included attending the short course on control of waterweeds at the University of Florida at Gainesville. I also discussed current topics of aquatic plant management with the staff of the Center for Aquatic Weeds at U.F., especially with Dr. William T. Haller who also kindly made the necessary contacts for the rest of my trip. Since CEL has focused its research interests on biological control of waterhyacinth, I also visited the laboratory at Fort Lauderdale. There I met Dr. Ted Center and discussed with him the latest developments in this area. My visit also covered operational aspects of aquatic plant management in Florida including programs in Polk County and on Lake Okeechobee.

METHANE/WATER HYACINTH,

Continued from page 1

After several days flow through the hyacinth channels, the water is clearer, waste compounds have been reduced, and the discharge stream meets water treatment standards.

To increase hyacinth growth rate and to remove polluting compounds from wastewater more effectively requires scheduled harvesting of the hyacinths, and scientists are studying which harvesting schedules best fit the seasonal growth patterns of the hyacinths.

The next part of the Disney World hyacinth system is the biogasification process in which harvested water hyacinths are anaerobically converted into pipeline quality methane gas. Encouraged by results of bench-scale tests, GRI built this scaled-up (1200-gallon) experimental unit which began operation in January 1984. Experiments with this test unit are expected to continue until 1987, when another scale-up will be built. This next scale-up may verify the economic suitability of the concept before design and construction of a full-scale commercial facility is attempted.

The pictured test unit is "designed to include the major physical, chemical, and biological operations and processes essential to the functioning of a full-scale biogasification plant." The unit has complete processing capabilities including water hyacinth and sludge preparation, feed blending, anaerobic digestion, gas treatment, and effluent handling. The effects of loading rates, particle size, hyacinth/sludge mixing, and pre-and post-treatment are being determined.

Water hyacinths are processed through a chopper and grinder to reduce particle size. Sludge from the primary clarifier is mixed with the water hyacinths and added to the digester as a feed blend. Bacteria in the reactor digest the feed, producing methane and carbon dioxide. The undigested residues are collected and processed for potential use as animal feed or fertilizer. The gas is then "cleaned up" (carbon dioxide, hydrogen sulfide and moisture are removed) for pipeline distribution.

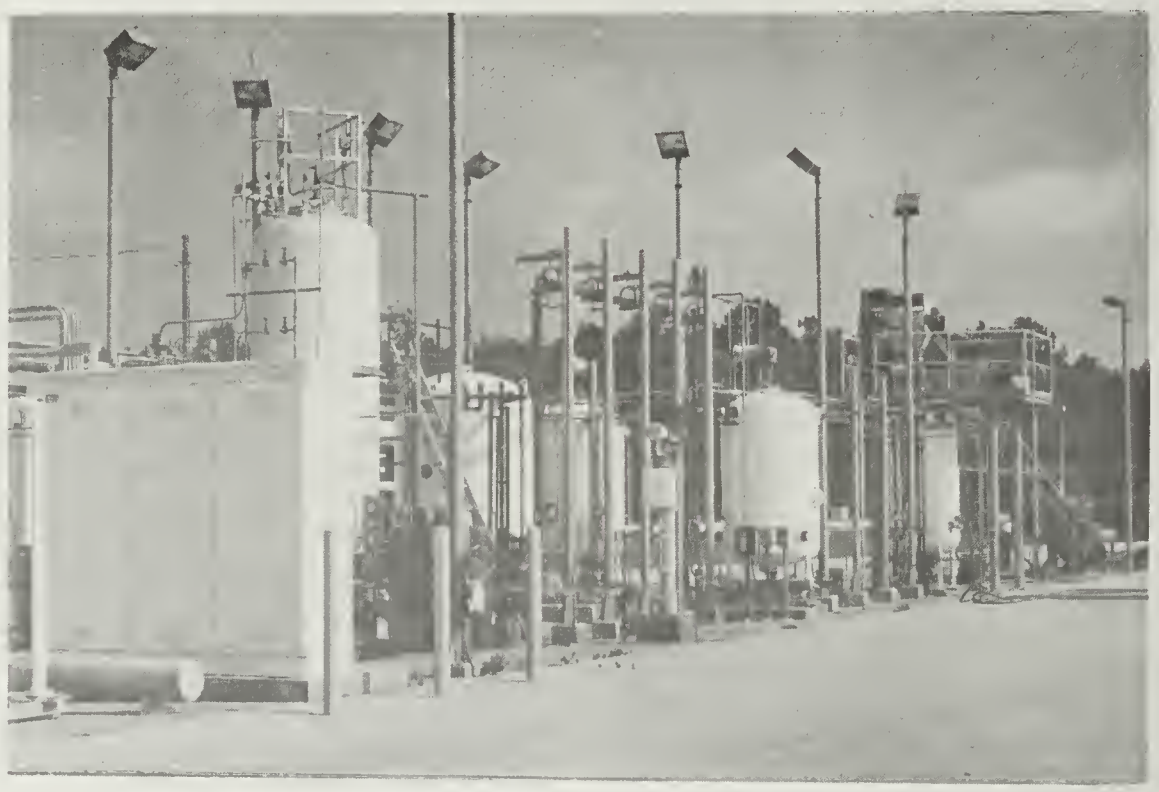
For more information on this waterhyacinth sewage treatment system, contact **Mr. Frederick M. Hueston, Manager, Water Hyacinth Project, Walt Disney World, P.O. Box 40, Lake Buena Vista, Florida 32830 USA, (305) 624-6448.**

For more information on the biogasification experimental test unit, contact Mr. Thomas D. Haynes, Manager, Biogasification Project, Gas Research Institute, 8600 West Bryn Mawr Avenue, Chicago, Illinois 60631 USA, (312) 399-8100.

D. Haskell/V. Ramey

The Aquatic Weed Program has about 40 articles and books on the biogasification of water hyacinths and about 50 on the use of water hyacinths in wastewater treatment systems.

For more information contact:
Aquatic Weed Program
2183 McCarty Hall
University of Florida
Gainesville, FL 32611 USA
(904) 392-1799



SANTEE COOPER AQUATIC WEEDS

You think **you** have problems!

The huge (176,000 acres) Santee-Cooper in South Carolina was created in 1940 from Lakes Marion and Moultrie and the first aquatic weed battle began in 1943. Today, 30,000 acres of *Egeria densa* infest the system, and in 1982 *Hydrilla verticillata* appeared. (Other nuisance plants include *Ludwigia uruguayensis, Ceratophyllum demersum, Najas minor, Alternanthera philoxeroides* and *Myriophyllum heterophyllum.*

Santee-Cooper serves as a reservoir for hydroelectric production, but also supports $45 million tourism and commercial/recreational fishing industries. They are major stakes in the battle against aquatic weeds, and the cost of control there now approaches $.5 million a year.

Helicopters (above) help in the control efforts. According to John Inabinet, Supervisor of Santee-Cooper's water quality and weed control section, a single helicopter can treat with herbicides in one day what it would take a crew six weeks to treat (about 500 acres). Diquat is used for egeria control, Aquathol K is used against hydrilla.

Part of the control effort is spread prevention. At a boat ramp, fishermen check their live wells and propellors in response to this warning.

For more information, contact John Inabinet, Supervisor of Water Quality Management, Santee Cooper, #1 Riverwood Drive, Monck's Corner, South Carolina 29461, USA (803) 761-8000.

AQUATIC PLANT JOURNAL CITATIONS

Information about aquatic plants is found in many journals representing many areas of science. Most of the research articles cited in the aquatic plant database are from 150 journals. (Nearly 200 other journals also are represented in the database.) Below are listed those 15 journals most often cited in the database. They are listed in descending order according to their numbers of citations. A list of names and addresses of 150 journals which publish aquatic plant research is available from the Aquatic Weed Program.

JOURNAL OF AQUATIC PLANT MANAGEMENT
Aquatic Plant Management Society
P.O. Box 16
Vicksburg, Mississippi 39180

AQUATIC BOTANY
Elsevier Scientific Publication Co.
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1000 AH Amsterdam
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The International Training Course on Aquatic Plant Ecology and Management was held June 10 through July 13, 1984 at the University of Florida. Participants attended the extension short course and then visited the laboratories and field experiments of a score of aquatic plant scientists from Florida to Virginia, seeing many waterweed infestations and control efforts along the way. Above, in Ft. Lauderdale, University of Florida scientist Dr. David Sutton explains the results of growth competition studies between *Hydrilla* and *Eleocharis*. Listening are, (l. to r.) Dr. B.M. Sharma (Univ. Ibadan, Nigeria), Dr. T.O. Robson (U.K.), Dr. Thai Van (Univ. Fla.), Dr. D.K. Saxena (Bareilly College, India) and Sutton.

More than a hundred Florida water management personnel attended the week-long **Extension Short Course on Aquatic Weeds** in June, held at the University of Florida. The course is held periodically to update field personnel on state-of-the-art control methods and to introduce them to new aquatic plant pests. Among the sixty presentations was this one by Mr. Richard Cromwell (IFAS Agric. Eng.) on how to calibrate spraying components using the 1/128th of an acre method.

On a recent visit to the remote Corkscrew Swamp (a sanctuary established by the Audubon Society in south Florida), several aquatic plant specialists were temporarily stumped when asked to identify this plant. Closely examining the nearest leaf, they found to their amazement the family and specie names written by an anonymous hand in ballpoint pen. "Of course," they exclaimed after a stunned silence, "Marantacae! Thalia geniculata!"

PISTIA STRATIOTES (WATER LETTUCE) RECORDED FROM FLORIDA IN BARTRAMS' TRAVELS, 1765-74

by Dr. Ronald L. Stuckey and Dr. Donald H. Les, Department of Botany, College of Biological Sciences, The Ohio State University, Columbus, Ohio 43210, USA

Pistia stratiotes (water lettuce) is considered by most botanists to be non-indegenous or foreign to the flora of Florida, as well as elsewhere in the United States, apparently having originated in the Old World tropics. Little information exists, however, regarding when water lettuce made its first appearance in the United States. To determine whether a species is native or alien, it is essential to obtain some record of when it first invaded the area. We have not yet learned of this information for *Pistia stratiotes* in Florida, but our attention was recently drawn to accounts of the water lettuce in the *Travels* (1-6) of John and William Bartram, 1765-66 and 1773-74 that they made while in Florida.

During the Bartrams' first trip, while searching for the source of the St. John's River, 31 December 1765, they both saw, and John described for the first time in their *Travels,* '...prodigious quantities of the pistia, which grows in great plenty most of the way from hence to the head of the river and is continually driving down with the current, and great quantities lodged all along the extensive shores of this great river and its islands, where it is entangled... and...all matted together in such a manner as to stop up the mouth of a large creek, so that a boat can hardly be pushed through them, though in 4 foot water; these by storms are broke from their natural beds and float down the river in great patches, the roots striking deep, often touch the muddy bottom, and there anchor and fasten, and are ready to catch and entangle those that drive down upon them, and all together gather mud, by the daily accumulation of which they are formed into islands which are very numerous in this river, and are much enlarged by these plants fixing on their shores." (1) On 12 January 1766 at or near Lake Loughman, John recorded "...great patches of the pistia...all entangled together, covering many thousands of acres on St. John's and its branches, which heads in numerous rich swamps and marshes." (1) A similar phenomenon was noted by him on 19 January below Lake Beresford near Spalding's Upper Store.

As described in his *Travels* (2,3) of 1773-74, William Bartram, upon seeing the water lettuce in the St. John's River, wrote a much more detailed description than his father had earlier provided.

"It being a fine cool morning, and fair wind, I set sail early, and saw, this day [April, 1774], vast quantities of the Pistia stratiotes, a very singular aquatic plant. It associates in large communities, or floating islands, some of them a quarter of a mile in extent, and are impelled to and fro, as the wind and current may direct. They are first produced on, or close to the shore, in eddy water, where they gradually spread themselves into the river, forming most delightful green plains, several miles in length, and in some places a quarter of a mile in breadth. These plants are nourished and kept in their proper horizontal situation, by means of long fibrous roots, which descend from the nether center, downwards, towards the muddy bottom. Each plant, when full grown, bears a general resemblance to a well grown plant of garden lettuce, though the leaves are more nervous, of a firmer contexture, and of a full green colour, inclining to yellow. It vegetates on the surface of the still stagnant water, and in its natural situation, is propagated from seed only. In great storms of wind and rain, when the river is suddenly raised, large masses of these floating plains are broken loose, and driven from the shores, into the wide water, where they have the appearance of islets, and float about, until broken to pieces by the winds and waves; or driven again to shore, on some distant coast of the river, where they again find footing and their, forming new colonies, spread and extend themselves again, until again broken up and dispersed as before."(3)

In Bartrams' *Travels, Pistia stratiotes* was recorded from the St. John's River system below Lake Beresford, at Lake Dexter, in Lake George, above Lake Harney, and on Salt Springs Run; also in the Suwannee River, according to the annotations in the published editions by Francis Harper.(1-3) At these places John and William Bartram both wrote of islets or floating fields of the bright green *Pistia.* William Bartram's drawings of the plants and animals seen on these journeys, never published by him, were retained in the John Fothergill Album at the British Museum (Natural History), London. Recently, the drawings were assembled with annotations prepared by Joseph Ewan and published by the American Philosophical Society.(6) Bartram's illustration of the water lettuce, shown with aquatic plants and animals that he encountered, is among them (Plate 59, described on page 85) and is reproduced here (Figures 1 and 2).

With reference to the initial question regarding when *Pistia stratiotes* first invaded Florida, the Bartrams' accounts are significant in that they date the species' occurrence in the state nearly a century earlier than data available from known herbarium specimens. The earliest specimens seen by the senior author are mostly from the St. John's River system and coastal localities. The following are noteworthy:(7) Abundant above Pilatka, St. John's River, Mar. 1872 (*J. Torrey s.n.,* NY); Tampa, Oct. 1877 (*A.P. Garber s.n.,* FLAS, PH, US); Lake Astachula, Sumter Co., Mar. 1879 (*J.D. Smith s.n.,* US); Hillsboro River above Tampa, Aug. 1880 (*A.H. Curtiss 2687,* FLAS, PH, US [The year is given only on the specimen at US]); Tidal Creek near Jacksonville, 16 Feb. 1882 (*J.D. Smith 337,* US).

Because water lettuce is known to have been present in Florida as early as the middle of the eighteenth century, it could be considered native to the state. However, accounts of the biology of the species by Holm, et al.(8) report of the nearly complete failure of North American plants to set seed, in contrast to African individuals which produce several seeds per plant. These observations implicate the absence of appropriate pollinators for the species, and therefore suggest that the water lettuce has indeed invaded the region.

The town of St. Augustine, founded in 1565, could have provided an early avenue for the invasion of *Pistia stratiotes* into Florida. It is considered to be the oldest city in the United States and its trade connections to the outside world are well known. Exotic plants were imported into the region from the time of its earliest settlement, and easily could have escaped into the nearby St. John's River.

Fig. 2. William Bartram's illustration of *Pistia stratiotes,* the rosulate-leaved plant.

Notes and references

Many versions of the lives and travels of John and William Bartram have been published. The following references have been used here:

1. Bartram, John. 1942. Diary of a journey through the Carolinas, Georgia, and Florida from July 1, 1765, to April 10, 1766. Annotated by Francis Harper. Trans. Amer. Philos. Soc. 33:i-iv, 1-120 + pls. I-XXII. Quotations, pp. 39, 42.
2. Bartram, William. 1943. Travels in Georgia and Florida, 1773-74: A report to Dr. John Fothergill. Annotated by Francis Harper. Trans. Amer. Philos. Soc. 33:121-242 + pls. 1-XXVI.
3. --------. 1958. The Travels of William Bartram: Naturalist's Edition, Edited with Commentary and an Annotated Index by Francis Harper. Yale Univ. Press, New Haven. 1xi, 727 pp. + 29 photographs and map. Quotation, pp.57-58.
4. Berkeley, Edmund, and Dorothy Smith Berkeley. 1982. The Life and Travels of John Bartram: From Lake Ontario to the River St. John. Univ. Presses of Florida, Tallahassee. xvi, 376 pp.
5. Cruickshank, Helen Gere, ed. 1957. John and William Bartram's America: Selections from the Writings of the Philadelphia Naturalists. The Devin-Adair Co., New York. xxii, 418 pp.
6. Ewan, Joseph. 1968. William Bartram Botanical and Zoological Drawings, 1756-1788. Amer. Philos. Soc., Philadelphia. x, 180 pp.
7. The specimens have been cited using the following standard herbarium abbreviations: FLAS, University of Florida, Gainesville; NY, New York Botanical Garden, Bronx; PH, Academy of Natural Sciences, Philadelphia; US, United States National Museum, Smithsonian Institution, Washington, DC.
8. Holm, LeRoy G., et al. 1977. The World's Worst Weeds: Distribution & Biology. Univ. Press of Hawaii, Honolulu. 609 pp.

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Herbicide Handbook of the Weed Science Society of America, Fifth Edition. by the Herbicide Handbook Committee, C.E. Beste, Chairman.1983. Weed Science Society of America, 309 West Clark Street, Champaign, Illinois, 61820, USA.515 pages.$10.00.

This handbook offers a comprehensive collection of terrestrial and aquatic herbicide data to researchers, teachers, and managers and personnel in the field. For each of its more than six hundred entries, the following information is given: nomenclature, detailed physical properties of the chemical, herbicidal use including application methods and rates, use precautions, physiological and biochemical behavior, behavior in or on soils, toxicological properties, synthesis and analytical methods, and sources of information including names and addresses of manufacturers. The herbicides are listed in alphabetical order according to common name. Indexes of chemical, common and product names are included.

The **SFWMD** is responsible for water management in 16 counties in central and south Florida. Its 15,673 square miles include more than 1,400 miles of canals and 2,000 square miles of water storage areas for flood control and agricultural use. Aquatic weeds are a major problem for SFWMD, especially hydrilla and water hyacinth. Other problem waterweeds include chara, water lettuce and spatterdock. SFWMD uses all forms of aquatic weed control, but necessarily relies on aquatic herbicides and mechanical controls. Every morning, many airboat crews prepare their boats and herbicidal mixtures and take to the field. Five crews work out of the Clewiston field office (above), one of several in the district. Herbicides used most often by SFWMD are 2,4-D, dalapon, dicamba, diquat, chelated copper and endothall. In areas of special environmental sensitivity, as in canals which lead directly to the Everglades National Park, herbicides are replaced by mechanical controls. *For information about the SFWMD, contact the South Florida Water Management District, 3301 Gun Club Road, P.O. Box V, West Palm Beach, Florida 33402, USA.*

University students in an aquatic plant control class listen to Dr. Joe Joyce (U.F. Center for Aquatic Weeds), just before they begin an identification excursion.

Hydrilla is no longer evident in a fluridone-treated plot on Big Lake, Umstead Park (Raleigh, North Carolina). Here, Dr. Ken Langeland (N.C. State) directs visiting scientists to the plot on the engine-restricted lake. In another test lake, hydrilla was controlled with diquat, and in a third, hydrilla was controlled with fenac, applied during a drawdown. In North Carolina, hydrilla and other aquatic weeds are being attacked by a concerted effort of several state agencies, steered by the Department of Natural Resources and Community Development and its Inter-agency Council on Aquatic Weed Control.

TEST-TUBE BIOCONTROLS?

"Application of genetic engineering technology to the development of a biocontrol agent for Eurasian watermilfoil and hydrilla is feasible," according to researchers at the US Army Corps of Engineers. They have proposed a plan to produce "field-ready formulations" of engineered microorganisms within twelve years. In the plan, scientists would find very-host-specific microorganisms, identify their traits and alter their genes to enhance pathogenicity, conduct bioassays and efficacy studies and finally register formulations for use and commercial production. For more information, obtain *Feasibility of Applying Genetic Engineering Technology to Aquatic Plant Control*, by J.C. Pennington, June 1984, US Army Corps of Engineers Information Exchange Bulletin, Vo. A-84-2 Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi 39180 USA.

BIOCONTROL SHORT COURSE SET

The Second International Short Course on Biological Control of Insect Pests and Weeds is planned for 13-25 May 1985, to be held in Albany, California. The intensive short course in being organized by the Divisions of Biological Control of the Univeristy of California at Berkeley and Riverside.

The course is to teach the theoretical and practical aspects of biological pest control in agriculture, forest, urban and aquatic ecosystems, and its target audience is university professors and lecturers, extension specialists, research scientists and graduate students involved in developing and implementing biological control programs in their countries. Participants will learn the methodologies for conducting biocontrol programs and will learn basic principles for conducting significant scientific research related to biological control.

The course will include classroom instruction, laboratory exercises, field study, conferences and travel, and will include case studies of successful biocontrol programs. Each participant also will conduct independent research on a topic related to biocontrol.

The course fee of US $700 covers course costs, but not cover living and food expenses or travel to and from California. The course will be limited to 25 participants, and selected applicants will be notified by February 15, 1985.

For additional information, contact **Dr. Miguel A. Altieri, Division of Biological Control, University of California, Berkeley, 1050 San Pablo Avenue, Albany, California 94706 USA.**

MIDDLE WATER WEEDS

The Midwest Aquatic Plant Management Society (MAPMS) is another active chapter of the national Aquatic Plant Management Society. Its one hundred members are among those who control the aquatic pests of a dozen mid-western states and include scientists, water managers and applicators. MAPMS produces the newsy MAPMS Newsletter (G. Douglas Pullman, Editor) and also convenes an annual general meeting during which papers are presented. The next MAPMS Annual Spring Meeting is set for 17-19 March 1985, in Fort Wayne, Indiana. Their society's annual dues are $10.00. For information about the MAPMS, contact Richard Bauer, 7150 Summerdale Drive, Dayton, Ohio 45424, (513) 236-9663.

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EWRS RESEARCH GROUP ON AQUATIC WEEDS

by Dr. Arnold H. Pieterse, Royal Tropical Institute, Department of Agricultural Research, Mauritskade 63, 1092 AD Amsterdam, THE NETHERLANDS

The European research group on aquatic weeds has been in existence for nearly twenty years. It was formed in 1966 under the European Weed Research Council (EWRC) and originated from a committee on aquatic weed control which was established in 1960. In 1975, when the EWRC was replaced by the EWRS (European Weed Research Society), a society open to individual membership, the objectives of the research group were formulated as follows:

1. To promote the interchange of information on aquatic weed problems between members of the Society by organizing symposia at regular intervals.
2. To encourage the co-operation between research scientists working in similar fields on common problems by forming working groups to consider specific topics.
3. To develop and maintain contact with other international organizations with similar interests.
4. To stimulate and encourage members to contribute items of information on aquatic weeds and news of individuals working on them to the EWRS Newsletter.

Aquatic Weed Symposia

Both during the time of the EWRC and that of the EWRS the main function of the group has been to organize a symposium every three to four years. These aquatic weed symposia proved to be very valuable for the content of the scientific programme as well as for the opportunity to meet colleagues from other countries. They were held respectively in 1964 in La Rochelle (France), in 1967 in Oldenburg (Germany F.R.), in 1971 in Oxford (U.K.), in 1974 in Vienna (Austria), in 1978 in Amsterdam (The Netherlands) and in 1982 in Novi Sad (Yugoslavia). The proceedings of the symposia have been edited by the research group.

During the period of 18 years between the first and the sixth symposium various changes have taken place. The relative interest in chemical control of aquatic weeds is decreasing because of growing apprehension concerning the use of herbicides in water. On the other hand there has been an increase in papers on biological and environmental control, and also on the biology and ecology of aquatic weeds, which implies that research workers have become more and more concerned with the relationships between control measures and plant survival strategy.

The symposia are not exclusively confined to Europe but papers dealing with aquatic weed problems in other continents are also included. In this context it may be noted that during the last two symposia there were several papers on aquatic weed problems in the tropics and subtropics.

In 1983 Dale Robson from the Weed Research Organization in Oxford, who had been the chairman of the group since 1967, resigned in connection with his retirement. His great ability and enthusiasm has been a major reason for the success of the symposia. I have had the priviledge to become the successor of Dale; at the moment the research group consists of seven members.

The Next EWRS Aquatic Weed Symposium

The next, seventh, symposium will be held in Loughborough, England, 15-19 September, 1986. It will be organized in co-operation with the Association of Applied Biologists and will also comprise the third UK aquatic weed conference. Especially for participants from outside Europe, the location is very convenient. In this regard we hope that many aquatic weed scientists from the USA will attend and that the contacts between the EWRS research group on aquatic weeds and the Aquatic Plant Management Society will be intensified.

Recently the research group has decided to publish a new book on aquatic weeds. It is felt that there is a need for a comprehensive up-to-date book on this subject. The chapters will be written by the members of the research group and various scientists working in other parts of the world.